Space Weather Technical Forecast

Issued on Sunday, 01 May 2022 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: X-flare from AR2992 on 30th from behind limb. Activity reducing, with decreasing chance of M-flares 1st May. Slight chance G1 Minor Geomagnetic storms on 1st May.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been High, with an impulsive X1.1 flare observed from region ex-2994 beyond the northwestern limb at 30/1347UTC. This region also produced an M1.9 flare at 30/1942UTC. The region has produced a series of CMEs, but all have been assessed as not Earth-directed. There are four regions on the visible disc, with all these arranged as alpha or benign beta regions. No Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind observed at L1 has been slowly declining from 500km/s to 450km/s, due to the mixture of a declining high speed stream from coronal hole 78, and the residual effects of a CME which arrived at Earth on 30th April. Density was mainly below average. Total interplanetary magnetic field, IMF, was weak, with the north-south component Bz, varying weakly. Phi angle was predominantly negative (towards the Sun). Geomagnetic activity has been Quiet to Unsettled throughout the period.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) was only very slightly elevated above background, having declined since the recent slight increase due to the M1.1 flare on the 29th. The high energy electron flux (greater than 2MeV) has varied between moderate and background levels, reaching a peak of 836pfu at 30/1645UTC. Electron fluence has been below the Active threshold (1e8 integrated pfu) with a falling trend. Fluence was 1.62e7 integrated pfu at 01/0000UTC

Four-Day Space Weather Forecast Summary

Solar Activity: Activity may reach Moderate levels on 1st May, but should soon decline to mainly Low or Very Low as the responsible region rotates further onto the far side of the Sun. There is then a very slight chance of further M-class flares from the remaining regions on the visible disc.

Solar Wind / Geomagnetic Activity: A CME which left the Sun on 29th April may glance the Earth on 1st May, but this is considered a low probability event. The high speed stream is expected to ease by the end of 2nd May, giving way to ambient conditions for the remainder of the period. Quiet to Unsettled geomagnetic activity is forecast through the next four days, but with a risk of Active or G1/Minor Storms on 1st May should the forecast CME affect the Earth.

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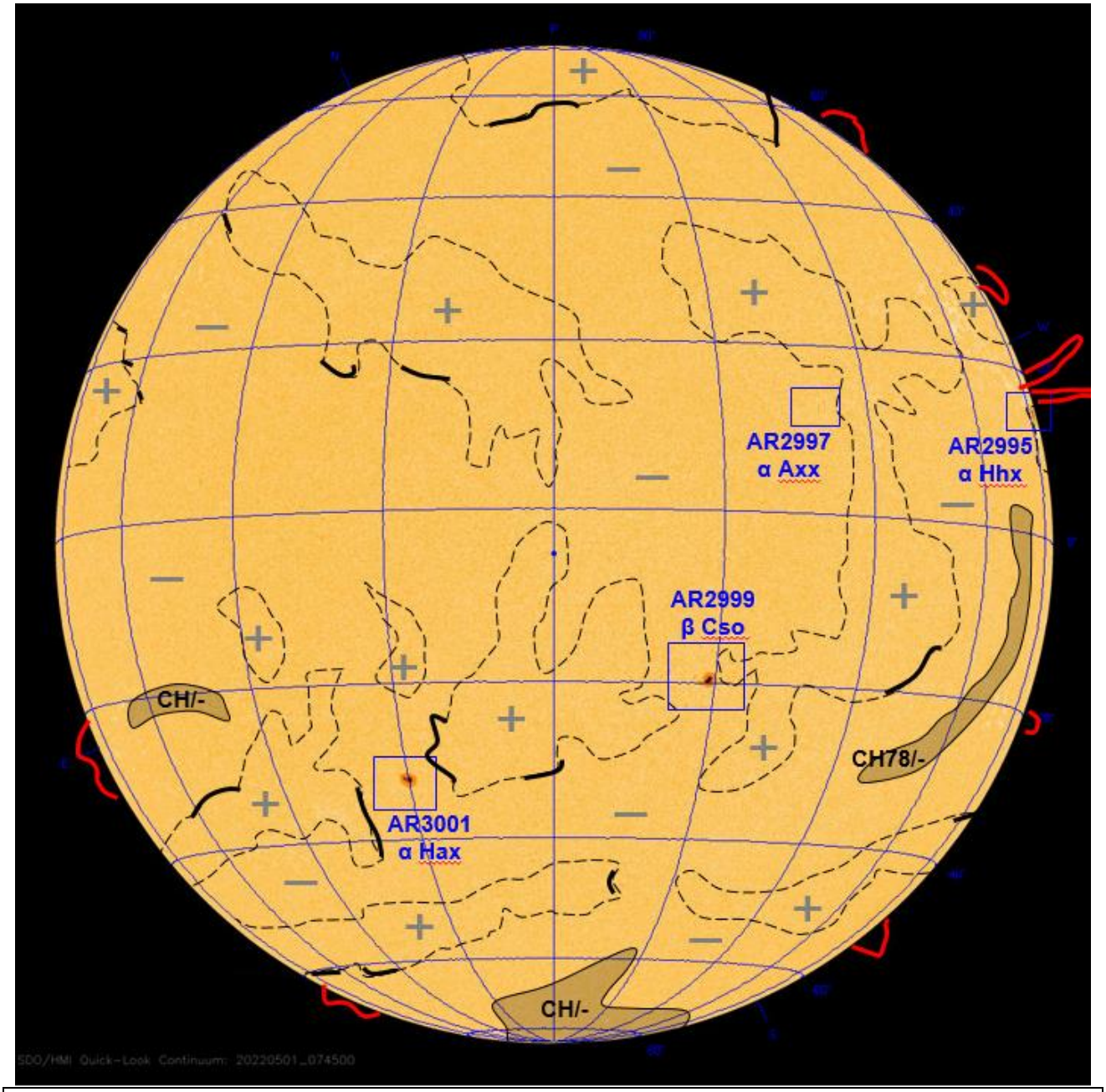
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is most likely to remain at background levels through the next four days. The high energy electron flux (greater than 2MeV) is increasingly likely to exceed the high (1e3 pfu) threshold through the period as the solar wind and any geomagnetic effects ease. Electron fluence is also increasingly likely to exceed the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 01/0800UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is a slight chance of a CME, which left the Sun on 29th April arriving at Earth on 1st May, although current Enlil modelling suggests an outside chance of a glancing blow.

The high speed stream from coronal hole 78 is fitfully declining and is expected to ease, with the solar wind returning to background levels through the next two days. No further coronal hole high speed streams are forecast to connect with the Earth through the period.

Generally Quiet to Unsettled geomagnetic activity is forecast through the next four days, but with a risk of Active or G1/Minor Storms on 1st May should the forecast CME affect the Earth.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	5	1	1
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: MOSWOC Enlil model, showing forecast CME arrival

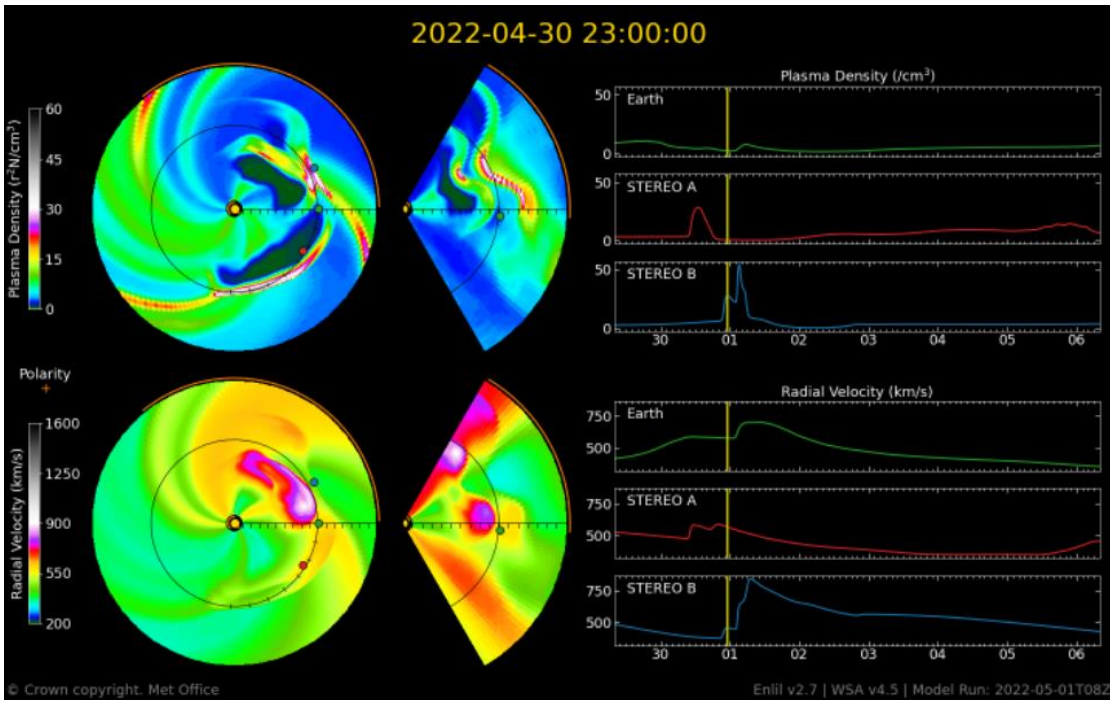

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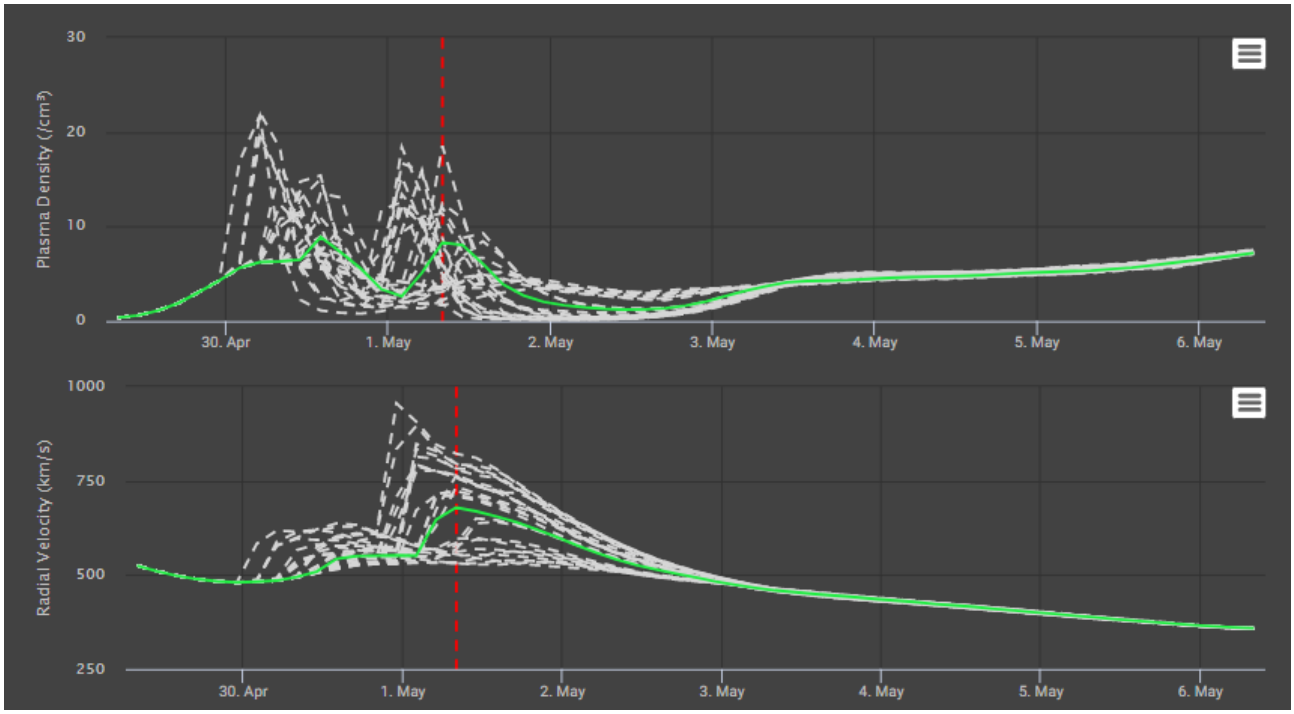
Figure 3: MOSWOC Enlil ensemble, showing range of potential arrival times for the CME.



Radio Blackouts - X-Ray Flares:

The risk of High solar activity is expected to reduce through 1st May. The source of this activity was ex-2994, a region which is now beyond the northwestern horizon, but with the magnetic prominences still discernible. The remaining regions on the disc all appear to be benign and stable, with no significant activity observed.

A previously active region (ex-2992) is due to return on 4th May, with signs from STEREO A imagery that this may still be an active feature and could produce high energy flares.
Solar activity may persist at Moderate during the remainder of 1st May due ex-2994, then mainly Low or Very Low through 2nd and 3rd May. The returning region then gives a risk of further Moderate activity from late on 3rd and into 4th May.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	5	10	10
Very Active	R3 to R5 X Class	Yes	1	1	1	1

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Figure 4: 24 hour GOES 16 X-ray flux with the X-class and M-class flares shown.

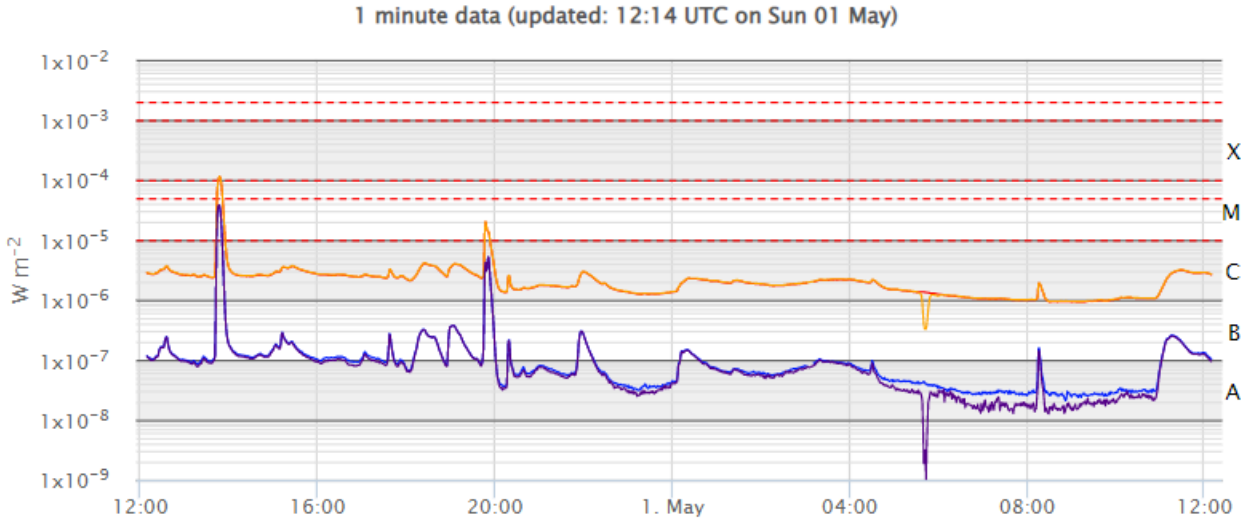
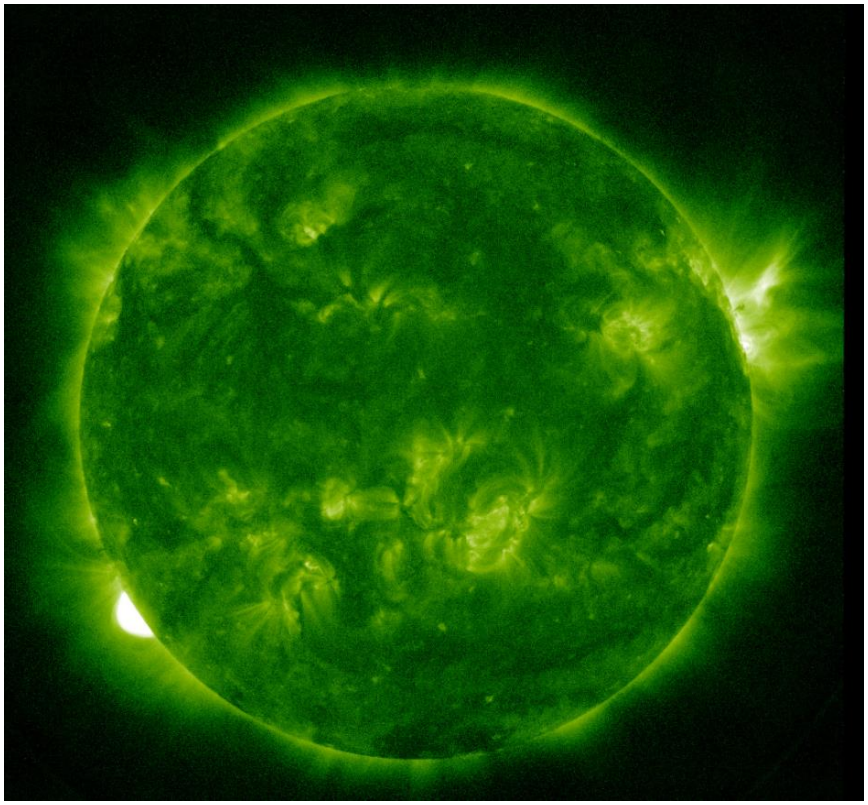


Figure 5: SDO AIA 94 imagery at 01/1154UTC. The magnetic looping of ex-2994 can be seen just beyond the top–right limb. A flare from returning region ex-2992 can also be seen close to the bottom-left of the image.



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) as measured by GOES-16 at GEO is at background levels, and is most likely to remain so through the next four days. However AR2994, which is just over the horizon of the northwest limb, is still able to give a proton enhancement at Earth giving any energetic particle release from any further flaring of this region. This risk decreases by 2nd May.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed at GEO is expected to slowly increase through the next four days, with an increasing risk of exceeding the high (1e3pfu) threshold. One of the main modifying factors is the high speed stream which is likely to be distorting the belts out of GEO and away from GOES 16. A further risk is the forecast CME, which should it arrive, could redistribute the electrons in the belts or distort their shape.

Electron fluence has followed a downward trend which is likely to reverse through the next four days, as the high speed stream eases. There is an increasing risk of the electron fluence exceeding the Active threshold (1e8 integrated pfu) through the period due to the chance of the increasing flux as a consequence of the radiation belts relaxing into their natural orbits.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	30	40	50
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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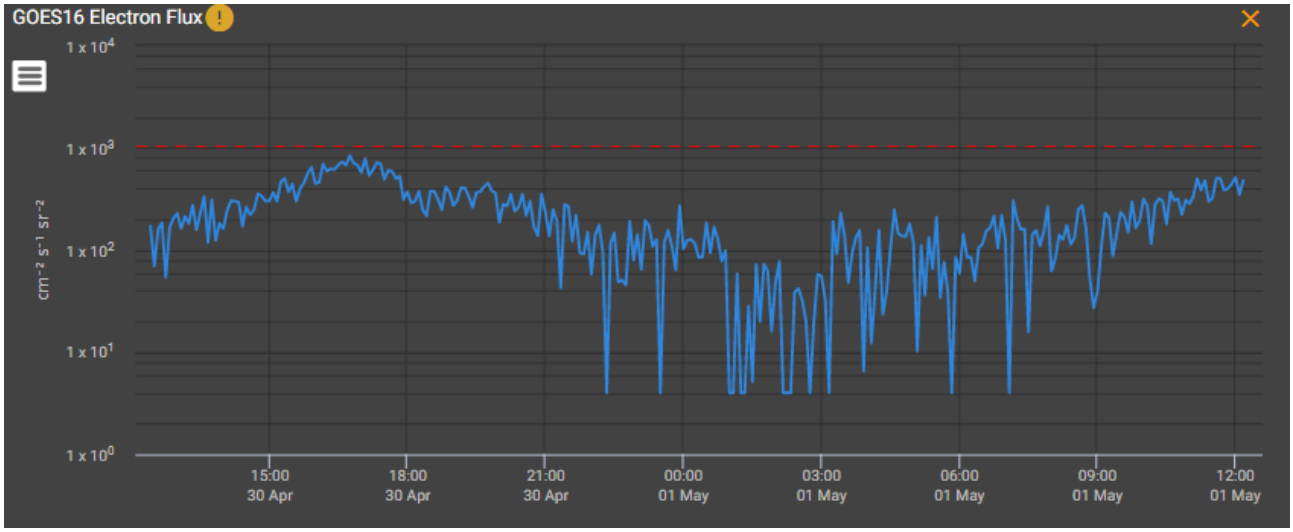
Figure 6: GOES 16 high energy electron flux



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